Indian and Northern Affairs Canada
Affaires indiennes et du Nord Canada

VOLUME 05

NORTHERN LAND USE GUIDELINES
Access: Roads and Trails

Canada

Table of Contents

Preface

Indian and Northern Affairs Canada (INAC) has revised its popular land use guidelines series. It is designed to guide land use activity on Crown land in the Northwest Territories and Nunavut. Activities on land under private ownership (e.g., First Nations or Inuit-owned land)[1] and land under municipal or territorial control (e.g., Commissioner's land) require direction from the appropriate agency.

Guidelines apply to land use activities on Crown land only.

These guidelines will assist proponents and operators in planning proposed land use activities, assessing related environmental effects and minimizing the impacts of these activities. They should be supplemented by local research, traditional knowledge, engineering or other professional expertise specific to a proposal and advice from the appropriate regulatory agency. Although every attempt has been made during the preparation of these guidelines to use up-to-date information, it remains the operator's responsibility to obtain the most recent information related to northern resource development and to follow current regulatory requirements.

Guidelines do not replace acts, ordinances, regulations and permit terms and conditions.

1 Aboriginal land refers to First Nations, Inuit, or Métis owned lands

Volumes in this series include:

- Vol. 01 Administrative Framework
- Vol. 02 Administrative Process
- Vol. 03 Applying Sustainable Development
- Vol. 04 Permafrost
- Vol. 05 Access: Roads and Trails
- Vol. 06 Camp and Support Facilities
- Vol. 07 Pits and Quarries
- Vol. 08 Mineral Exploration
- Vol. 09 Hydrocarbon Exploration
- Vol. 10 Other Land Uses
- Vol. 11 Abandonment and Reclamation

The series is available electronically at **www.publications.gc.ca**. Readers are encouraged to visit the site for updates and revisions to the series.

For further information concerning the subject matter contained in this guideline series, please contact:

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YUKON

NOTE: *Effective April 1, 2003, responsibility for Indian and Northern Affairs Canada's Northern Affairs Program (land and resource management) was transferred to the Government of Yukon. For information on land-use in the Yukon, contact the office below:*

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Acknowledgments

In the 1980s, Indian and Northern Affairs Canada published a series of six guidelines in a handbook format, intended to help operators of small to medium-scale projects carry out activities in northern Canada in an environmentally sensitive manner. These handbooks, commonly called "The Blue Books," have been widely distributed and quoted. Their success is a tribute to the efforts of the original authors and contributors, and to the departmental steering committee that guided their preparation.

This new series of northern land use guidelines is, in part, an update of the earlier series. This work was directed by a steering committee made up of Northern Regional Office staff and Northern Affairs Program staff in Ottawa. Much of the information and many of the photographs presented in this series were obtained in consultation with land use administrators and resource managers in the Northwest Territories and Nunavut.

CHAPTER

01

Introduction

The purpose of this volume is to provide guidance on the construction and operation of roads and trails on Crown land in the Northwest Territories and Nunavut. If you are not operating on Crown land, it is your responsibility to contact the appropriate landowner for any land use guidelines that may be in place.

Due to the remote nature of the Northwest Territories and Nunavut, road construction is often required to conduct land use activities. This volume presents strategies for planning, constructing, operating and reclaiming roads in an efficient and environmentally responsible manner. Consultation with appropriate experts is recommended for specific engineering and geotechnical concerns.

CHAPTER 02

Northern Roads and Trails

Roads and trails are often used to access land use activity sites in northern Canada due to the high cost and seasonal restrictions associated with travel by air or water. Existing road infrastructure is limited and access routes must often be planned and constructed before a primary land use activity like mining can begin. Development of a new access route in a remote, inaccessible area can have positive economic effects; however, it can also have negative impacts on land, water and cultural resources. Mitigation techniques should be outlined during the planning stage of road development to minimize potential environmental impacts.

Cold climatic conditions lead to the use of unique road-building techniques in the Northwest Territories and Nunavut. Winter roads that are constructed on frozen bodies of water and on frozen ground protected by layers of snow and ice are frequently used. The presence of permafrost in northern Canada requires different construction practices as surface disturbance can lead to permafrost melting and subsequent ground subsidence.

2.1 Classification

Roads are classified by season of use, size and purpose (Table 2-1). An all-season access road has a durable, all-weather surface that can be used by vehicles at any time of the year without damaging the land surface. A winter road is only operational when the ground is sufficiently frozen and there is an adequate layer of snow to prevent damage to the ground by vehicles.

2.2 Permitting

Most road or trail developments require a land use permit from the appropriate land use regulator. The application should include environmental background information and a description of the type of access, design specifications and development schedule. The application should also explain how identified environmental impacts will be avoided or minimized during construction and operation. If camps, quarries or pits are required during construction, the land use permit application should include details about these developments.

Proponents should discuss their proposed development with local Aboriginal groups and area land users. INAC and other regulatory authorities strongly encourage community engagement prior to and during the land use permitting process.

Other authorizations may be required depending on the nature of the development. The purpose of and the responsible authority for these authorizations is outlined in Table 2-2. Regulatory authorities should be contacted before applying for permits so that proponents understand the requirements and time frames necessary to obtain required permits. For more information on regulatory processes and applicable legislation, consult the *Administrative Process* volume of this series.

Table 2-1. All-season and winter road classifications

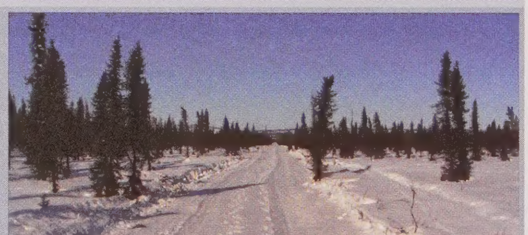
ALL-SEASON ROAD	CHARACTERISTICS	EXAMPLE
Haul Road (logging road, forest road, local road)	• Connects developed resource areas to highways or communities • Designed to carry heavy trucks at speeds of approximately 40 to 80 km/h	
Access Road (pioneer road, fire road, spur road, shoo fly)	• Provides initial access to resource areas for exploration • Requires minimal design work • Designed to carry low traffic volumes at low speeds	
Trail (push trail, cut line)	• Provides access for a limited duration • Degree of clearing varies from merely pushing down vegetation to clearing a narrow right-of-way	
WINTER ROAD	**CHARACTERISTICS**	**EXAMPLE**
Compacted Snow Road	• Winter use haul road • Constructed of compacted snow and/or ice	
Winter Access Road	• Constructed by dragging and levelling the surface to allow smoother travel • Water may be used to build up ice for the roadbed	
Winter Trail (push trail, cut line)	• Established for winter use by a single pass of a tracked vehicle using a blade, if necessary	

Table 2-2. Authorizations that may be required for road construction

PERMIT	PURPOSE	RESPONSIBLE AUTHORITIES
Land Use Permit	Use and occupation of land associated with a road	• Indian and Northern Affairs Canada (Inuvialuit Settlement Region) • Land and Water Boards (Mackenzie Valley – Northwest Territories) • Indian and Northern Affairs Canada (Nunavut)
Water Licence	Use of water or deposition of waste into water, for example, water used to build a winter ice crossing or deposit sewage from a road camp	• Northwest Territories Water Board (Inuvialuit Settlement Region) • Land and Water Boards (Mackenzie Valley – Northwest Territories) • Nunavut Water Board (Nunavut)
Quarrying Permit*	Obtain granular materials	• Indian and Northern Affairs Canada
Quarry Lease*	Long-term access to granular materials	• Indian and Northern Affairs Canada (Nunavut only)
Fisheries Authorization	Work in fish-bearing waters, for example, installation of a culvert	• Fisheries and Oceans Canada
Timber Permit	Clearing timber prior to road construction	• Government of the Northwest Territories • Government of Nunavut
Access Authorization	Access to and work on Aboriginal private lands	• Aboriginal private landowners
Access to a Public Highway Permit	Required prior to constructing a road that intersects a public highway	• Government of the Northwest Territories (NWT only)

*In Nunavut, quarrying activities on Inuit-Owned Land must be authorized by the appropriate Regional Inuit Association.

FIGURE 1. Contact your local INAC resource management officer to discuss project options prior to applying for a land use permit.

CHAPTER 03

Planning and Design

Proper planning will result in a road that uses the most suitable terrain, thereby reducing environmental impacts. A well-designed road will also result in efficient construction and operation.

Route selection is the first stage in the planning process and should be done before determining the type of access needed and associated road design. Existing and new environmental information must be gathered and used to determine what type of road is feasible and suitable given the environmental conditions. A systematic process should be followed for identifying alternative routes, evaluating these routes and choosing a preferred route based on consideration of all of the key planning issues.

The entire lifespan of the road should be considered during planning. For example, if a trail is likely to be upgraded to a haul road at a later date, the additional time spent finding a route with gentle grades, stable terrain and a minimum number of stream crossings will eliminate the need to construct an entirely new road in the future.

3.1 Site Conditions

3.1.1 Existing Information

Existing administrative and environmental information about the development area should be used to delineate the general area, the proposed location of the route and alternatives. Proponents are encouraged to identify and use existing roads where possible to reduce costs and the environmental footprint of the development.

Some examples of questions that can be answered using existing administrative and environmental information are listed below.

Administrative

- Who owns the land over which the proposed route will pass?
- Which land use regulators have authority over the land?
- Is the project within a region that has an approved land use plan?
- Who are other land users within the area (e.g. trappers, communities, tourism operators)?

Environmental

- What are the environmental and terrain conditions?
- Are there known environmental or terrain concerns within the area?
- Are land use, water quantity and water quality data available for the project area?
- Where is critical fish and wildlife habitat located within the area?

Some specific examples of information requirements and sources are outlined in Table 3-1.

Table 3 1. Information used for access route planning

INFORMATION CATEGORY	INFORMATION SUB-CATEGORY	SOURCES
Environmental	• Topography and drainage • Surface vegetation • Sensitive landforms (e.g. pingos or eskers)	• Aerial photographs and maps • Local INAC office • Appropriate resource managers or regulatory boards • Local operators and residents
	• Water management	• INAC Water Resources Division www.ainc-inac.gc.ca
	• Timber/forestry	• Government of the Northwest Territories, Environment and Natural Resources www.forestmanagement.enr.gov.nt.ca • Government of Nunavut, Department of Environment
	• Fish and wildlife habitat	• Fisheries and Oceans Canada www.dfo-mpo.gc.ca • Environment Canada www.ec.gc.ca • Territorial environment departments
Engineering	• Road design • Construction methods • Water crosssings and bridges	• Engineers • Examination of local roads • Field investigations • INAC resource management officer
Archaeological/cultural	• Location of archaeological sites and heritage resources • Traditional use areas (e.g. berry-picking sites, traplines, cabins)	• Prince of Wales Northern Heritage Centre (Northwest Territories) http://pwnhc.learnnet.nt.ca • Department of Culture, Language, Elders and Youth (Nunavut) www.gov.nu.ca/cley • Inuit Heritage Trust (Nunavut) www.ihti.ca • Field investigations
Reclamation	• Reclamation standards	• Local INAC office • Appropriate resource managers or regulatory boards • Territorial environment departments

3.1.2 Field Investigations

Once a general area for the route has been identified, field investigations should be conducted to collect more detailed information on environmental conditions so that the final configuration of the route can be chosen. A combination of on-the-ground assessments and aerial reconnaissance should be conducted along the entire proposed route during both summer and winter to delineate the full range of environmental conditions. The ground and aerial assessments should provide information on topography, hydrology, soils, permafrost, geotechnical properties, wildlife habitat, and heritage resources. Field investigations will also identify areas that should be avoided or that will require special management. Pre-development field investigations also provide a baseline record of environmental data that will help in setting reclamation goals. All field data collected should be included in the land use permit application.

If a pit or quarry is needed to obtain construction materials for the road, specific field investigations should be carried out to determine if a suitable site is located within the area of the proposed route. Further information on pit or quarry development is available in the *Pits and Quarries* volume of this series.

3.1.3 Stable Terrain

High, dry and flat ground is an ideal location for most roads as these areas are blown clear of snow during winter, leading to frozen and stable ground. When thawed, these areas are typically well drained. It is not always possible to locate a road in ideal terrain, but ground that is particularly susceptible to erosion or subsidence should be avoided. Areas to avoid include:

- unstable slopes and slide areas;
- deep valleys because they retain snow that inhibits ground freezing; and,
- wet areas such as peatlands, wetlands, seeps and springs.

Except for stream crossings, water bodies should be avoided to prevent erosion and sediment deposition into the water. To prevent sedimentation and erosion, vegetated buffer strips of at least 30 m width are required to be left between roads and water bodies.

In tundra areas, roads are often situated on or near eskers because they are well drained and stable; however, eskers also provide critical habitat for wildlife. Known denning areas should be avoided when planning development on or near an esker.

FIGURE 2. Determine if existing roads can be used. Proper planning may have prevented the network of roads shown in this photograph.

FIGURE 3. Field investigations should be conducted in both the summer and the winter to ensure that the road is built with consideration for the full range of climatic and hydrological conditions.

FIGURE 4. In permafrost terrain, avoid road construction on patterned ground.

FIGURE 5. Pingos are ice cored hills that are unique to permafrost terrain. Vehicles and equipment are prohibited within 150 m of a pingo.

3.1.4 Permafrost

Some areas of perennially frozen ground contain significant amounts of ground ice. Disturbance of these areas should be avoided as they could melt and cause ground subsidence, potentially leading to soil erosion, instability of engineered structures and loss of habitat. Areas of ground ice are not always identifiable from surface features, so field investigations should be conducted to determine the extent and depth of permafrost and near-surface ground ice. In general, the following areas should be avoided in permafrost terrain due to high near-surface ground ice content:

- patterned ground;
- fine-grained soils, particularly clays; and
- sedge wetlands and peatlands.

Areas in permafrost terrain that have recently experienced a forest fire are prone to erosion, but a few years after the fire, once the ground ice has melted, these areas are more stable than older areas of unburned forest.

In discontinuous permafrost regions, it may be possible to avoid areas of permafrost altogether. Areas of black spruce trees or peatlands indicate the presence of ice-rich permafrost. Isolated patches of permafrost can also be cleared and allowed to melt prior to road construction. Further information on techniques to minimize permafrost disturbance is available in the *Permafrost* volume of this series.

3.2 Road Design

Once the location of the route has been determined, road design can be undertaken. Road design involves planning the road alignment, grades, embankments and surfaces, and requires an understanding of both local environmental conditions and transportation requirements, such as the purpose of the road, expected vehicle loads, frequency of use and duration of use.

The objective of road design is to construct a road that will be safe and minimize environmental disturbance. A well-designed road will be less prone to events that cause environmental disturbance and will require less maintenance to deal with issues such as wind-blown trees, blocked culverts, excessive rutting, washouts, ponding and bridge scouring.

For safety, road grades and curves must be suitable for all vehicles that will use the route. A wider right-of-way should be cleared on sharp curves to reduce the risk of accidents. Ideally, road grades should be less than six percent, which can often be accomplished by following the contours of the

FIGURE 6. Road grades and curves should be designed to be safe and minimize environmental disturbance. In this case, a wider curve and a lower grade would be safer and less prone to erosion.

land. Lower road grades will help reduce soil erosion and operating constraints as steeper grades often require large loads to be towed. In steep terrain, the use of lower road grades may increase the number of fills required and overall road length, so site-specific evaluations should be conducted to determine the best design.

The choice of proper road construction materials can also reduce operating and maintenance costs. Coarse-grained material should be used for road construction because it drains well and is less susceptible to frost heave. In wet areas, geotextiles can be used to distribute the bearing load and to prevent mixing of sub-grade materials with aggregates.

3.2.1 Drainage Control

Controlling drainage involves design aspects or structures that keep the road dry, including stream crossings. A detailed understanding of natural drainage patterns will assist in designing drainage control structures that will be appropriately sized for expected flows and will follow natural drainage courses. These measures will reduce erosion and ponding, resulting in lower long-term maintenance costs. The best time of the year to plan drainage control is during spring when all streams, seeps and springs are flowing. It is also important to understand high precipitation events during other seasons. If possible, a full year of observations is ideal. Important environmental factors to consider when determining expected flows and local drainage patterns include:

- total annual precipitation (rainfall and snowfall);
- high precipitation (storm) events;
- vegetation cover;
- topsoil and subsoil types; and,
- length of slopes.

Roads constructed in areas of soil with low infiltration rates, such as fine-textured silts and clays, will require more extensive drainage control measures as more water will be restricted to the surface. This is also the case in permafrost terrain where water is restricted to a thin active layer extending from the ground surface to the top of the permafrost. High precipitation events can lead to

erosive sheet flow. Rapid runoff from steep slopes is also a concern, especially on south- or west-facing slopes where snowmelt is more rapid. Non-forested areas may also be more susceptible to erosion.

Stream crossings are drainage control structures that should be particularly well planned as erosion and sedimentation into streams can affect water quality and fish habitat. A detailed watershed delineation should be completed for each stream crossing to determine the design requirements for a high flow, 100-year flood event. Once expected peak flows are understood, design considerations include:

- minimizing the number of stream crossings and using existing crossings where possible;
- selecting or constructing gently sloped approaches at right angles to the stream where the channel is straight, unobstructed and well defined, with a low bank height;
- locating stream crossings at sites with coarse-textured, well-drained material;
- locating stream crossings at least 500 m downstream of known fish habitat, such as spawning beds and rearing, feeding and overwintering sites; and,
- considering the high-water mark in the design of stream crossings.

Proponents should contact Fisheries and Oceans Canada and Transport Canada before conducting any stream crossing work to ensure compliance with regulations. More information on planning, constructing, operating and maintaining stream crossings can be found in the Canadian Association of Petroleum Producers' document *Pipeline Associated Watercourse Crossings* at www.capp.ca.

3.2.2 Visual Impacts

Where safety permits, the route should be designed to minimize its visual impact, especially in areas with high tourism or scenic value. The preferred mitigation technique is to avoid these areas; however, if avoidance is not possible, methods to reduce visual impacts include:

- minimizing long straight sections of road to reduce lines of sight; and,
- preserving a visual barrier between the route and public roads or streams by using buffer zones or doglegs.

3.3 Cultural, Subsistence and Recreational Values

Some areas of land are particularly valued for subsistence or recreational activities, such as traplines, hunting areas, canoe routes or tourism lodge sites. Aboriginal groups, territorial tourism departments, INAC resource management officers and local residents can identify sites of particular cultural, subsistence or recreational importance along a proposed route.

Representatives of existing interests, such as cabin owners or trappers, should be consulted during the planning phase so that their concerns can be addressed in the road design or alignment. The land use permit may also contain specific conditions to protect and minimize disruption to these existing interests.

FIGURE 7. Part of the planning process involves identifying and consulting with other land users near the proposed development.

3.4 Archaelogical and Cultural Resources

Roads should be sited so that disturbance of archaeological and cultural sites is avoided. Archaeological and cultural sites should also be considered when constructing a winter road. The road corridor should be investigated during the summer prior to construction to identify potential archaeological or cultural sites. Territorial governments can provide information on documented sites through the Prince of Wales Northern Heritage Centre in the Northwest Territories and the Department of Culture, Language, Elders and Youth in Nunavut. Aboriginal

FIGURE 8. Verifying the route prior to construction can avoid unnecessary false starts such as this one

groups, communities and governments also have information on traditional-use areas.

If an archaeological or cultural site is discovered during construction, work in the area should be stopped immediately and the INAC resource management officer and territorial government notified. Signs of an archaeological site can include arrowheads, old encampments and evidence of buildings.

3.5 Verifying the Route

Once route planning has been completed and prior to applying for a land use permit, the entire route should be checked in the field and marked with flagging tape. Global Positioning System (GPS) coordinates should be recorded while in the field and provided to the INAC resource management officer. Verifying the route reduces the chance of building a road in an unsuitable area and the need to rebuild the road elsewhere, thereby reducing costs and minimizing the environmental footprint of the road. Marking the route with flagging tape before clearing begins also ensures that the clearing equipment operator can easily follow the intended route.

CHAPTER 04

All-Weather Road Construction

This section outlines surface preparation activities and all-weather road construction methods. Clearing and construction should be scheduled when the ground surface is strong enough to support equipment without rutting or erosion. The proponent should contact the local INAC resource management officer prior to commencing construction. Construction should be suspended when conditions could result in serious erosion, such as heavy rainfall or when sub-grade soils are saturated. To avoid rutting and erosion in permafrost terrain, overland travel is not permitted during summer months and road construction should only take place during late fall or winter when the active layer is well frozen.

Field conditions encountered during road construction may require changes to the plan that was provided in the application for a land use permit. Prior to making these changes, the proponent should consult with the INAC resource management officer and the land use regulator to determine if the modifications require regulatory approval.

4.1 Surface Preparation

Surface preparation for a road includes removal of trees, shrubs and ground cover along the right-of-way prior to road construction. Clearing should be restricted to the approved right-of-way and to the minimum width necessary to conduct safe operations. Rights-of-way should be wide enough to allow road surfaces to dry quickly. If the right-of-way is too narrow, the road surface will be shaded and wet or icy, resulting in unsafe operating conditions.

Clearing vegetation is discouraged in some areas, such as permafrost terrain where the shade provided by vegetation may prevent ground thaw. Vegetation may also be left to provide a visual barrier between the road and a public highway or other land use. Buffers of uncleared land must be left beside water bodies to prevent erosion of riparian areas and the deposit of sediment into streams and lakes.

4.1.1 Trees

In forested areas, trees should be felled onto the right-of-way to minimize disturbance of the adjacent forest. Trees should be felled away from water bodies to avoid blocking streams and impacting water quality. Where it is safe and practical, standing live or dead trees along the route that provide wildlife habitat should be saved.

When clearing with a dozer blade, ensure that trees break off at the ground surface and avoid uprooting trees as this can tear the surface organic layer,

FIGURE 9. Proper scheduling of road construction will avoid rutting and erosion.

FIGURE 10. Clear only the minimum width necessary for road use.

exposing and thawing ice-rich mineral soil beneath. It may be preferable to hand cut trees instead. Remaining trees that lean over the right-of-way or into the adjacent forest should also be removed as they pose safety hazards and can tear the surface organic layer if they fall. The use of U-blades for clearing trees and other vegetation is discouraged as it usually results in a high number of pushouts on the sides of the route, which may cover brush below, causing a fire hazard.

Land use permits may include conditions for saving and stacking merchantable timber. In general, trees larger than 12 cm in diameter should be saved. For more information, contact the Department of Environment and Natural Resources, Government of the Northwest Territories or the Department of Environment, Government of Nunavut.

4.1.2 Shrubs

Once trees have been removed from the site, shrubs can be cleared. However, clearing of ground cover and the surface organic layer is strongly discouraged as it protects permafrost from disturbance and prevents erosion in non-permafrost terrain.

One of the least intrusive methods of clearing shrubs is to "walk down" the vegetation with a bulldozer blade at a fixed height. Small trees and shrubs are pushed down by the blade and the weight of the machine compresses the felled vegetation. This method of clearing is common for trails, such as seismic lines, where conventional wheeled vehicles will not be used. Some shrubs that have been walked down may not break and may recover during the following season, which will help prevent soil erosion and enhance vegetation recovery at the end of operations.

FIGURE 11. Brush can be walked down using a bulldozer.

FIGURE 12. A brush cutter can be used to cut and dispose of brush.

4.1.3 Brush Disposal

Once trees and shrubs have been cleared, the resulting brush should be cleared off the right-of-way. The brush disposal method used depends on the size of the right-of-way and the type of vegetation. The land use permit will often specify how brush is to be disposed of but, in general, brush should be disposed of progressively as clearing proceeds and disposal should be completed along the entire route prior to expiry of the land use permit. Brush should not be disposed of in or near water bodies. In some cases, brush can be salvaged and used to control erosion along the route. For instance, stacked brush on the downhill side of a slope can slow and trap sediment.

The lopping and scattering technique is used when vegetation that was pushed down during clearing does not lie flat on the ground. Branches are removed and stems are cut into lengths so that the vegetation lies flat on the ground, enhancing decomposition.

Windrowing and compaction involve piling cut brush in long rows on the side of the right-of-way and compacting the piles using heavy equipment to increase decomposition. Windrows should be placed at least five metres away from standing timber to reduce the hazard of a fire. Breaks of approximately ten-metre width should be left in the windrow at approximately 300-metre intervals to allow wildlife passage.

Brush can be disposed of by mulching with a wood chipper or a brush cutter. The resulting wood chips can be scattered on the ground and will decompose more rapidly than windrowed brush. This method reduces the risk of fire and the accumulation of snow on the right-of-way in comparison with windrowing.

Complete disposal of brush by burning is often required within the first 100 m adjacent to the intersection of a public road or water body. Brush piles should be placed in the middle of the right-of-way to minimize the risk of fire spreading to surrounding vegetation. Set fires must be monitored at all times. Burning should not be conducted in permafrost terrain with high ground ice content as it could cause ground subsidence.

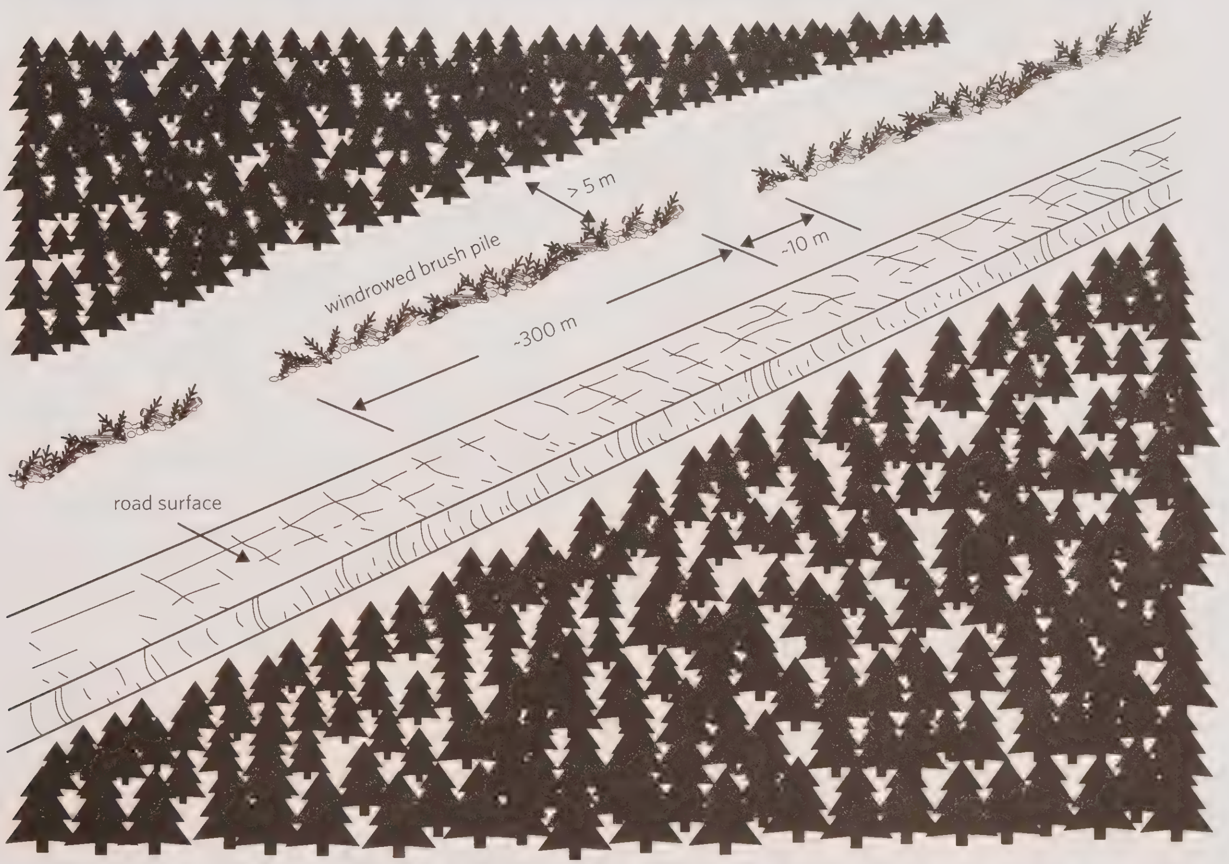


FIGURE 13. Openings of 10-m width left in windrows at 300-m intervals should ensure adequate passage for wildlife, and also reduce the fire hazard. Windrows placed at least 5 m away from standing timber reduce the risk of a fire. (1994 INAC Access Trails and Roads Guidelines)

4.1.4 Grubbing

Removal of stumps, roots and organic topsoil, known as grubbing, may be required to complete clearing for an all-weather road. Land use permits will often require the removal of tree stumps greater than 20 cm in diameter. To avoid erosion, grubbing should be minimized, particularly in areas of fine-grained soils or wet areas. If grubbing in fine-grained soils is unavoidable, it should be conducted during dry weather. Grubbing is not necessary for winter road construction or in areas where deeper fills will be used.

Disposal methods for grubbed material are the same as those for brush disposal, except for organic topsoil, which should be stockpiled separately from other materials for future reclamation use. Topsoil contains native plant seeds and organic matter that aid vegetation re-establishment. Stockpiles should be placed at a location that will not interfere with operations, will allow for the drainage of meltwater and will not be eroded by surface runoff.

FIGURE 14. Brush can be used as a sediment trap on steep slopes.

FIGURE 15. Improper disposal of brush in forest vegetation. Leaners should be cut down and brush windrowed.

4.2 Cuts and Fills

Cutting and filling is a road construction technique in which earth materials are excavated from one area and used to fill in an adjacent area to reduce the angle of a slope. Fills should use cut material from the upslope as cuts on the downhill side of a slope can lead to soil erosion. To ensure the stability of cuts and fills on slopes:

- Fill material should be compacted.
- The tops of cut slopes should be rounded.
- In unconsolidated material, the slope of the cut or fill should have a horizontal to vertical ratio of at least 2:1.
- Benches or breaks should be constructed on the slope to act as surfaces for revegetation.
- Rip-rap or cribbing should be used to slow surface runoff and erosion.
- Topsoil, seeds and mulch can be spread to enhance revegetation.

Cuts and fills should not be made on slopes in ice-rich permafrost terrain because they are prone to slumping. If a cut is unavoidable in permafrost terrain, the backslope should be nearly vertical to allow the ground to thaw and establish its own final position. A wide ditch at the base of the cut can contain the thawed material, which can be removed as required.

Fill from a borrow pit can also be used on level ground to protect areas prone to thawing and heaving, such as peatlands or other ice-rich permafrost terrain. To avoid disturbing the ground with road-building equipment, the fill should be end-dumped from an established roadbed.

4.3 Drainage and Erosion Controls

Drainage and erosion controls progress from relatively simple structures in flat terrain to more complex structures in steeper terrain. In flat areas, roads can be crowned so that runoff drains to either side of the right-of-way, leaving the surface dry. In areas with gentle slopes, roads should be outsloped so that the downslope side of the road is slightly lower than the upslope side to ensure effective drainage across the road. In steep or wet areas, water should be channelled into drainage control structures designed to carry greater volumes, such as ditches and cross drains.

FIGURE 16. The slope of this road has been reduced by fill excavated from the adjacent cut. Drainage and Erosion Controls

4.3.1 Drainage Control Structures

Parallel ditches are troughs that follow the road grade along the upslope side of the road to intercept water before it reaches the road. These are usually required for roads on steep slopes. To reduce erosion, parallel ditches should be constructed of coarse-grained material, and areas prone to erosion, such as ditch corners and discharge points, should be reinforced with geotextiles or rip-rap. To avoid sediment deposition into water bodies, ditches should drain into well-vegetated areas.

Cross ditches are shallow trenches that extend across the road in a downslope direction to drain ponded water from the uphill side or from the road surface. Cross ditches should extend beyond the right-of-way into vegetated areas to avoid scouring and soil erosion. The number of cross ditches required will depend on the length and slope of the particular road segment.

Berms are low mounds of earth fill that are constructed along the shoulder of a road in the path of flowing water to divert its direction and prevent erosion. Berms act as a dam and should be intercepted by cross ditches at regular intervals to allow water to flow away from the road.

Cross drains are pipes that extend through the roadbed to drain water from the uphill side of the road. These should be used on roads that are constructed of fill material with parallel ditches beside the road. To ensure that water will flow through them, cross drains should be located below the level of the parallel ditches. To prevent cross drain failure from frost heave, coarse-grained bedding materials should be used. The roadbed material should also be coarse grained and well packed to ensure that water does not erode around the cross drain. The cross drain should be properly sized and situated to accommodate the expected volume of water to prevent road washouts. The downstream end of a cross drain should not hang above the level of the ground as the resulting falling water will cause erosion below the outlet.

In areas of ice-rich permafrost, flowing water can lead to rapid thawing and erosion of the ground so water should be channelled under a road through cross drains rather than cross ditches on the surface. Cross drains can be stacked on top of each other to maintain drainage in the event that the lower cross drain freezes.

FIGURE 17. This cross drain is covered with coarse-grained granular material for frost protection

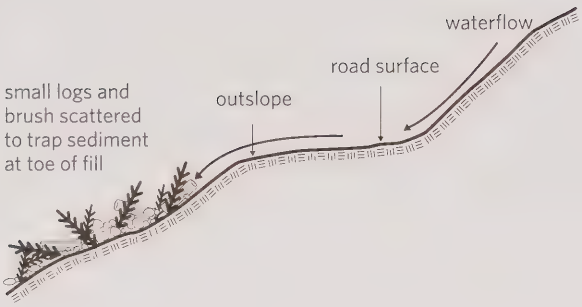


FIGURE 18. Sloping can be used to direct water off a road on a gentle slope. (modified from Hardy Associates (1978) Ltd., 1984)

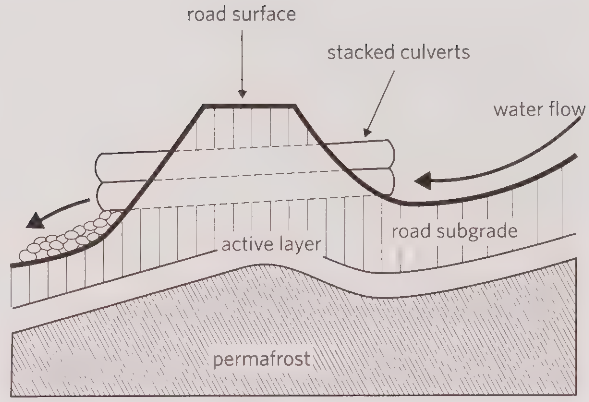


FIGURE 19. Stacked culverts can be used in permafrost terrain to ensure continuous drainage even if the bottom culvert becomes frozen. (modified from Hardy Associates (1978) Ltd., 1984)

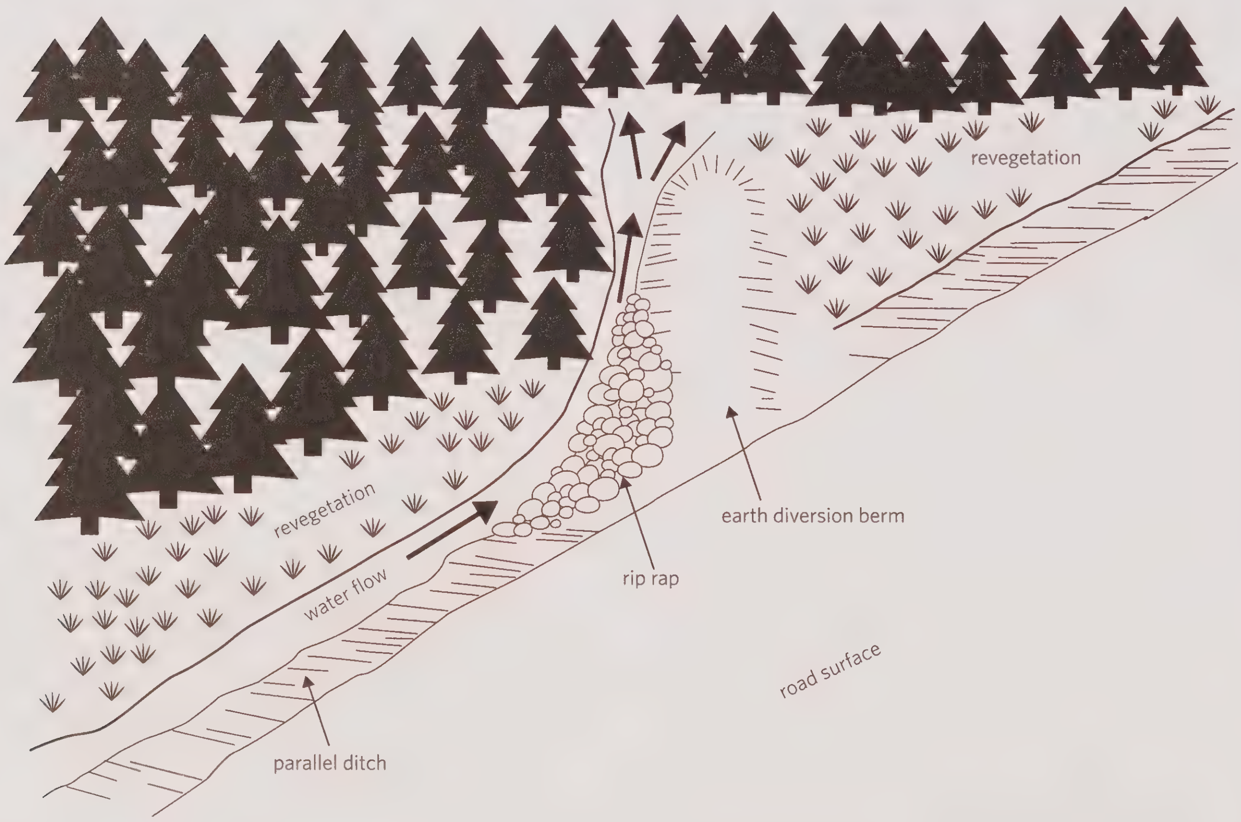


FIGURE 20. Diverting water away from the road and into a vegetated area at regular intervals will limit erosion and protect the roadbed. Directing runoff into a sedimentation pond is even more effective. (modified from Department of Transportation, Government of the Northwest Territories, 1993)

4.3.2 Erosion Control

Effective erosion controls, such as filter bags, silt fences or mats, can be used to slow runoff and reduce erosion where there is flowing water. In areas of higher velocity flow, such as ditches, ditch blocks can help control water speed and trap sediment. Ditch blocks are barriers to water flow that can be constructed of natural materials, including logs, cleared vegetation or rocks, or imported materials, such as sandbags. Spacing of ditch blocks should be determined by an engineer and will depend on the gradient and length of the ditch, soil texture and volume of runoff. Rip-rap should be used to armour the areas of highest velocity runoff, such as drainage channels and bridge abutments. Vegetation in ditches can also help control erosion and can be encouraged by seeding.

4.3.3 Drainage Icings

In cold weather, drainage control structures, particularly on slopes and at stream crossings, are prone to blockage by ice. Icings can also occur in flat terrain where areas of uneven snow removal or shading cause variable freezing of the active layer, forcing groundwater to the surface where it spreads and freezes. Pressure caused by icings can damage engineered structures and the build-up of ice on roads is a safety concern. If icings are observed, attempt to keep small channels thawed to promote continuous water movement.

Cross drains are particularly prone to icing. Methods to moderate this problem include:

- using open-ditch drainage;
- insulating cross drains;
- creating a frozen area above cross drains to block the winter flow of groundwater; and,
- installing a steam-circulating or electric-wire circuit in the cross drain to prevent freezing.

FIGURE 21. (Top) Ditch blocks and vegetation can be used to slow sediment movement in ditches parallel to the road.

FIGURE 22. (Middle) Silt curtains and matting can be used to control erosion near water bodies.

FIGURE 23. (Bottom) Icings can spread across a road and create a safety hazard.

4.4 Stream Crossings

Most roads will intersect several streams that will require various stream crossing methods. Stream crossings on all-weather roads can be temporary or permanent and include the use of fords, culverts or bridges. The use of logs for stream crossings is prohibited. The goal when building a stream crossing is to prevent erosion of riparian areas next to the stream and to avoid sedimentation into the stream as these situations could affect fisheries and wildlife habitat. There are several activities that should be avoided when constructing stream crossings:

- Minimize or eliminate in-stream activities as they tend to mobilize sediment, restrict stream flow or divert the natural stream course.
- Do not deposit soil or organic material into a stream.
- Avoid cutting stream banks to reduce the amount of sediment entering the stream.

Stream crossings should be located on stable ground at a narrow section of the stream with a gently sloped approach. Throughout construction, effective erosion controls, such as silt fences, should be used to prevent sediment from entering the stream. Engineered structures, such as culverts and bridges, should be installed progressively as construction of the road proceeds to eliminate the need for fording.

In-stream work may be required, for instance, to construct bridge abutments. While in-stream work is in progress, water-diversion channels or dams may be required to divert water from the stream bed. To allow fish passage, these structures should not block more than one third of the stream width and should be removed upon completion of construction. For more information on protecting fish and fish habitat while constructing stream crossings, refer to Fisheries and Oceans Canada at www.dfo-mpo.gc.ca.

4.4.1 Fording

Fording involves a vehicle travelling through a stream bed and may be acceptable under the following conditions:

- The crossing will not result in erosion and sedimentation into the stream or alteration (e.g. compaction or rutting) of the channel bed and banks.
- The stream bed is composed of non-erodible, coarse-grained material.
- Disturbance to riparian vegetation is minimized.

Fording should not be conducted in known fish-bearing streams, but if the crossing is unavoidable, fording should be restricted during spawning and migration periods. If sediment is inadvertently deposited into a stream, it must be removed immediately. The locations and proposed frequency of use of stream fords should be identified in the land use permit application.

FIGURE 24. Fording of this stream has resulted in rutting, sedimentation and erosion of the channel banks.

4.4.2 Culverts

Culverts are the most common stream crossing method for smaller streams. Professional engineering advice should be sought for installation of culverts to ensure that they are sized to accommodate the entire stream channel width and the highest annual flows. This will require a good understanding of local hydrology.

Culverts should be buried into the bed of the stream channel to a minimum of 20 percent of the culvert diameter at both the upstream and downstream

ends. This will promote the deposit of natural stream bed materials on the bottom of the culvert to maintain fish habitat and ensure that the water depth inside the culvert will be level with the water depth in the stream. Culvert alignment should approximate the existing stream channel alignment to mimic the natural stream flow, which will prevent bank erosion and channel scour. Culverts should extend a short distance beyond the toe of road fill material to prevent blockage at the end of the culvert by eroded soil. Granular material should be placed on top of the culvert to a minimum thickness of half the diameter of the culvert to prevent damage from vehicles travelling over.

In permafrost terrain, warm air circulating through culverts during summer may lead to thawing of permafrost in the roadbed and ground instability. To prevent thawing of permafrost, insulation can be placed around culverts during installation or flexible covers can be placed on the ends of large culverts to reduce the circulation of warm air. These covers should be removed in early winter to accommodate high water levels in the spring.

4.4.3 Bridges

Large, fast-flowing streams may require the construction of a bridge. Professional engineering advice should be sought for placement and construction of a bridge. Bridges should be high enough to permit the passage of water during periods of peak flow and ice during breakup. Sufficient clearance is also required in navigable waterways, and more information can be obtained from Transport Canada at www.tc.gc.ca. Bridge supports should be aligned to direct flow away from stream banks, but where this is not possible, banks should be armoured. Portable bridges are most appropriate for temporary roads because they can easily be removed, resulting in minimal disturbance to the stream.

FIGURE 25. (Top) A portable bridge is most appropriate for stream crossings on temporary access roads.

FIGURE 26. (Left) Incorrect sizing of culverts can lead to erosion and damage to the road

FIGURE 27. (Right) Bridge abutments should be constructed out of the flood plain to avoid erosion and restricting stream flow.

CHAPTER 05

Winter Access

Roads and trails that are only used during winter, when the ground is frozen, are common in the North. Frozen ground is much harder than unfrozen ground and can withstand greater vehicle loads as the formation of ground ice increases soil strength. A surface layer of snow also protects the ground surface from rutting and the potential for thermokarst erosion. In winter, the frozen surfaces of lakes and rivers should be accessed, where possible, to reduce impacts on the land.

All-terrain vehicles and tracked vehicles can be used on all types of winter access routes but, because of their higher ground pressure, conventional wheeled vehicles should only travel on compacted snow or ice roads.

5.1 Surface Preparation

In some cases, it may be necessary to clear trees or brush from the route. Brush can be used as fill in wet areas. Brush can also be used to insulate permafrost terrain, but this technique should not be used for all-weather roads as decomposing vegetation can destabilize the roadbed.

Before winter road construction can proceed, the ground should be frozen and there should be sufficient snow cover to protect the ground surface from the tires or tracks of vehicles. The land use permit will specify the minimum snow depths and the timing of vehicle access to ensure the ground is frozen.

Once vehicles are permitted on the road, some surface preparation, such as snow clearing and packing, is usually required to enhance ground freezing and protect the ground surface. The amount of surface preparation required depends on weather conditions, size of vehicles using the road and frequency of vehicle use. A small-scale winter trail may not require any surface preparation if it is to be used by low ground pressure vehicles for only a few passes.

When clearing or packing snow, bulldozer blades should be raised off the ground using mushroom shoes or smear blades (Figure 34) to avoid cutting the tops of hummocks, tussocks or high spots, which can lead to ground thaw and subsidence during spring. The road should be allowed to settle for a few days after the first compaction before allowing traffic as compacted snow gains strength

FIGURE 28. A smear blade raises the bulldozer blade off the ground surface.

FIGURE 29. A low ground pressure vehicle, such as a snowcat, can be used for a first pass to compact snow on a winter road.

with time. Snow windrows on either side of the road created by snow clearing should have breaks at regular intervals to allow wildlife passage and drainage of meltwater in the spring.

To build a more durable road that can accommodate heavy vehicles, water can be sprayed on the road to create ice layers that build up the road surface and protect the ground. Alternatively, the strength of the snow layer can be enhanced by disaggregating the surface layer and then repacking it and allowing it to harden. Disaggregating snow by tilling or running it through a snow blower will result in a stronger road surface.

In areas where there is not enough snow to protect the ground surface and vegetation, snow can be hauled from nearby water bodies, captured using snow fences or manufactured using snow-making machines, then spread along the road and compacted. When there is a lack of snow over a wider area, an aggregate ice road can also be constructed. Blocks of ice can be mined from adjacent lakes and end-dumped to form the road base. Water can then be sprayed on the blocks to bond them together.

FIGURE 30. The road surface can be built up with ice using a water truck with a sprayer.

5.2 Scheduling

5.2.1 Opening

Commencement of winter road construction depends on air temperatures and snow conditions. The opening date is usually designated in the land use permit (generally November 15), but can be changed at the discretion of the INAC resource management officer depending on weather conditions. After the opening date, the road can be opened to lightweight tracked vehicles that will compact snow on the road surface to enhance ground freezing. Pre-packing the snow will also minimize disturbance to the ground surface associated with using drags or blades. There should be at least 10 cm of compacted snow on the road before heavier wheeled vehicles are permitted to operate.

5.2.2 Closing

Winter roads should be closed before the ground thaws and vehicle travel causes rutting. The closing date is usually designated in the land use permit (generally April 15), but can be changed at the

discretion of the INAC resource management officer depending on the road and weather conditions.

Melting usually occurs first on south-facing slopes, stream approaches and road sections with dark surfaces, and these are good indicators that road closure is imminent. Sufficient time should be allowed for road closure, including the removal of all equipment and stream crossings. As air temperatures approach 0°C, the frequency of road inspections should be increased to ensure that the road is shut down before rutting occurs. With approval from an INAC resource management officer, road use may sometimes be extended a few days past the closing date by allowing vehicle travel at night when temperatures are below 0°C.

FIGURE 31. (Top) Winter roads are not ready for use by heavy wheeled vehicles until there is at least 10 cm of packed snow. Visible grass on this road indicates that there is less than 10 cm of snow.

FIGURE 32. Ponded water and a lack of snow indicate that the ground is thawing and this winter road should be closed immediately.

5.3 Water Use

Roads used by heavy vehicles during winter months can be strengthened by applying successive layers of water. Applying many thin layers of water to the roadbed and allowing them to freeze will result in a harder surface than building a road using several deep layers of water. An ice road surface can provide the following benefits:

- a smoother road surface requiring less maintenance;
- better protection of the ground surface; and
- a longer road life.

If water is required for winter road construction, a water licence may be required and water withdrawal protocols prescribed by Fisheries and Oceans Canada should be followed.

5.4 Ice Roads on Water Bodies

Ice road construction on bodies of water can be easier, more cost effective and have less environmental impact than winter road construction on land. The Government of the Northwest Territories' *A Field Guide to Ice Construction Safety* provides guidelines for appropriate ice thicknesses for winter roads on bodies of water.

5.5 Stream Crossings

Stream crossings for winter roads range from simple fills to engineered structures, including snow fills, ice bridges, culverts and bridges. All crossings should be located along gently sloped stream banks to minimize soil erosion. Ice and snow thickness should be sufficient to protect the stream banks from erosion (minimum 10 cm). Clean snow should be used to construct approaches to crossings and fills to ensure that debris does not enter the stream during spring.

Snow fills are the smallest scale winter stream crossing and involve compacting snow in the stream bed to create a road surface. They should only be used in streams that freeze to the bottom and should be removed, or notched, in the spring so that they do not impede stream drainage.

For streams that develop a solid ice cover, but do not freeze to the bottom, an ice bridge can be built to cross the stream. An ice bridge can be built by removing snow from the ice surface to increase the

FIGURE 33. A well-constructed snow fill located adjacent to a new bridge.

FIGURE 34. A poorly constructed snow fill consisting of mixed brush and snow.

FIGURE 35. An ice bridge built over a large stream channel.

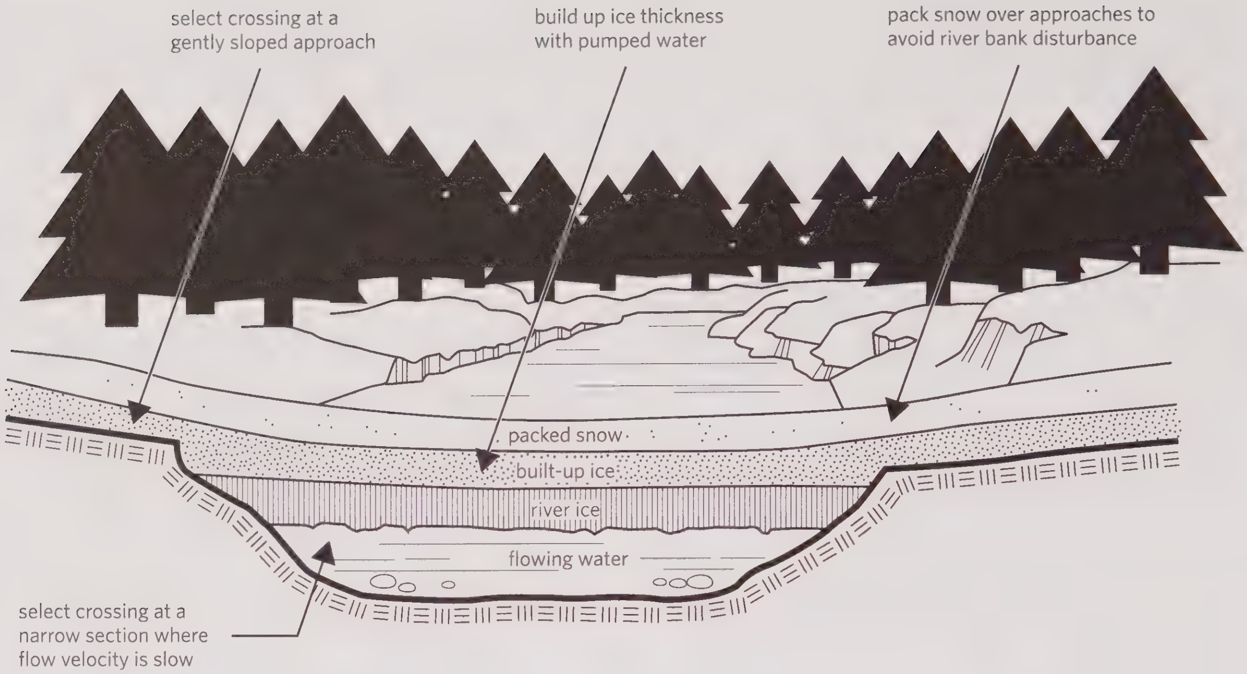


FIGURE 36. Typical ice bridge location and construction. (modified from Deparment of Transportation, Government of the Northwest Territories, 1993)

ice thickness. Water can then be used to increase the ice thickness in successive shallow layers. The Government of the Northwest Territories' *A Field Guide to Ice Construction Safety* recommends appropriate ice thicknesses for stream crossings.

Ice bridges must not obstruct the flow of water in a stream by causing it to freeze to the bottom. The resulting dam could create an icing that would spread beyond the stream banks, damaging both vegetation and the road. Overwintering fish and aquatic mammals would also be negatively affected. More information on protecting fish and fish habitat while constructing a snow fill or ice bridge is available from Fisheries and Oceans Canada at www.dfo-mpo.gc.ca.

As an alternative to ice bridges, pipe culverts can be placed in streams that do not develop a solid ice cover. Culvert installation must be preplanned and carried out during summer as described in Section 4.4.2. For fish-bearing streams, however, bridges or arch culverts, are preferable to the use of pipe culverts to maintain fish habitat. These bridges retain the natural stream bottom and slope.

All snow, ice and other construction materials associated with a stream crossing, including culverts, must be removed from the stream bed in the spring before freshet to allow free passage of water and fish. Removal of stream crossings should occur progressively along the right-of-way as the winter road is closed to minimize in-stream work. In some cases, a v-shaped notch cut into the middle of the stream crossing will allow for the passage of water and result in removal of the rest of the snow or ice during the spring freshet.

CHAPTER 06

Operations

Operations include the establishment of operating conditions that protect the route, such as weight restrictions, and regular monitoring and maintenance that ensure the route continues to function with minimal impact on the environment.

6.1 Operating Conditions

Operating conditions for road use, such as appropriate vehicle loads and operating times, should be established to protect the integrity of the road and the safety of its users.

During wet periods, roads can become soft and rutting is more likely to occur. To preserve the roadbed, vehicles should keep off road shoulders and out of parallel ditches. In extremely wet conditions, the road should be closed to traffic.

Load limits can be implemented on roads to avoid rutting and should be based on road engineering specifications and local experience. On all-weather roads, limits are commonly used during spring when the road is saturated and its load-bearing capacity is at a minimum. Limits should account for vehicle speed, weight and frequency of vehicle loads. Load limits on winter roads may be based on the depth of the snow cover. For winter roads that cross over water bodies, limits can also be based on the ice thickness, how the ice formed and water pressure below the ice.

Dust suppressants are used to maintain visibility on roads during the summer months. Where possible, water should be used as a dust suppressant and the use of water may require a water licence.

Dust suppressants should only be used with the approval of the appropriate land use regulator, territorial environment department and INAC resource management officer. Proponents may be required to notify the public and property owners in the area. For more information on dust suppression techniques, review the Government of the Northwest Territories' *Guidelines for Use of Dust Suppressants on Commissioner's Land in the Northwest Territories* or the Government of Nunavut's *Environmental Guideline for Dust Suppression*.

6.2 Monitoring and Maintenance

Regular monitoring of a road will allow for continual assessment of its performance and quick identification of areas that need to be repaired. The frequency of monitoring depends on the size of the road, its use, and potential risks to users and the environment. Typical monitoring activities include observation of drainage and erosion control structures, and stream crossings. Observations should also include current weather conditions and their effect on the route.

Regular maintenance is required to protect the structural integrity of the road and the cleared right-of-way, maintain drainage control structures and minimize erosion. Regular maintenance activities include:

- cleaning or repairing drainage and erosion control structures;
- grading the road surface to minimize rutting, potholes or channelling of water;

FIGURE 37. Regular monitoring will identify areas prone to erosion that may need to be redesigned.

- removing vegetation that overhangs the road to enhance drying and visibility; and
- maintaining vegetation or revegetating slopes and ditches to minimize erosion.

Well-documented monitoring and maintenance logs can be used to identify long-term trends and problem areas along the road that may need to be redesigned.

6.2.1 Drainage Control Structures

The performance of drainage control structures should be monitored after their installation, particularly during periods of high runoff, such as the spring freshet or heavy rainfall events. Scouring, flooding and displacement of rip-rap in ditches and berms are indicators that the structure is inadequate and should be upgraded as soon as possible. In some areas, natural drainage patterns may not be noticeable until after the road has been constructed and erosion or ponding occurs. In these areas, drainage structures will need to be added as problems are identified.

The structural integrity of bridges and culverts along the road should be assessed regularly. The morphology of the stream channel should also be monitored as any changes may affect bridge or culvert performance. Bridges and culverts should be inspected and cleaned regularly. During winter, culverts should be checked regularly for icing.

6.2.2 Permafrost Terrain

Drainage patterns in flat permafrost terrain are difficult to delineate because of gentle slopes and low precipitation rates. During summer, groundwater is confined to a thin active layer above the permafrost and may drain laterally across a road surface. Due to these difficulties in planning for drainage, post-construction monitoring of drainage control structures is particularly important in permafrost terrain to determine if more drainage structures are required.

Filled areas built on ice-rich permafrost can be subject to uneven thawing of the foundation soil, especially if they are constructed of fine-grained soil. Differential settling can lead to significant lateral spreading, cracking or sloughing of the embankment side slopes. Regular monitoring and maintenance are required to identify, fill and level affected areas.

FIGURE 38. Culverts should be monitored and cleaned regularly to ensure that they continue to function properly.

FIGURE 39. Regular monitoring will identify areas where drainage controls are inadequate and need to be redesigned

6.2.3 Snow

Clearing fallen or wind-blown snow is a routine maintenance activity required to allow the passage of vehicles. Best practices for clearing snow include:

- staking or flagging culverts and berms to avoid damaging them;
- creating breaks in snowbanks at regular intervals to allow wildlife passage; and
- removing snowbanks before freshet to allow the road to drain.

Normal traffic use of a road during winter will eventually cause washboarding, which can increase vehicle wear and damage. This can be prevented by grading and dragging the snow.

Throughout winter, and especially during spring, the entire road surface should be kept covered with white snow because soil on the road surface absorbs heat, accelerates ground thawing and reduces the length of time the road can be used during spring. Bare spots should be covered with snow as soon as possible. Soil should not be mixed with snow for use as fill.

6.3 Access Management

At times, it may be necessary to restrict or manage access to a road or trail, particularly if there are health, safety or wildlife concerns. Further information on access management strategies can be obtained from the local INAC resource management officer.

FIGURE 40. Differential settlement can occur in ice-rich permafrost terrain.

FIGURE 41. Clearing snow is part of routine winter road maintenance

CHAPTER 07

Spills

Spills can involve chemicals, hydrocarbons or other hazardous materials. Spills of reportable quantities must be reported immediately to the 24-hour spill line at 867-920-8130. A list of immediately reportable spill quantities is available in INAC's *Guidelines for Spill Contingency Planning* at www.ainc-inac.gc.ca/ai/scr/nt/ntr/pubs/SCP-eng.asp

7.1 Spill Contingency Plan

A spill contingency plan must be in place during all phases of road construction and operation, and must be submitted with the land use permit application. Unexpected spill events do occur and a plan will help operators respond to them quickly and effectively. The spill contingency plan should be implemented immediately after a spill event. The plan outlines a logical order of how operators should respond to a spill, resources available on-site for spill response, and agencies and individuals that need to be notified. All personnel working on the site should be aware of and understand the plan so that they can respond effectively to a spill. A spill contingency plan template is provided in INAC's *Guidelines for Spill Contingency Planning*.

7.2 Spill Prevention

Hydrocarbon spills from equipment are a major source of environmental damage and are often preventable. Equipment should be properly maintained and in good working condition to minimize potential leaks from hydraulic hoses and other working components. Drip trays can be placed under equipment when it is not in use to catch hydrocarbon drips.

7.3 Spill Response

Spill response includes stopping, containing and reporting a spill event. A well stocked spill response kit should be available on-site. Once a spill has been contained and reported, photographs should be taken of the spill area, the extent of the spill should be delineated and a cleanup strategy should be developed. Ensure that there is never an ignition source in the vicinity of spilled flammable products.

FIGURE 42. Unexpected spill events do occur and a spill contingency plan will ensure that all operators are prepared to respond to them quickly and effectively.

CHAPTER 08

Closure and Reclamation

8.1 Reclamation Goals

The key question that should be considered when defining the reclamation goals for a road is whether it will be used in the future for a different purpose or whether it will be permanently decommissioned. The route should be designed with the final end use in mind. Reclamation goals will require the approval of the appropriate regulators, and should be discussed with community members and Aboriginal groups.

Reclamation goals will form the core of the closure and reclamation plan that will be required by the applicable land use regulator for roads that are being decommissioned. These plans are not usually required for trails. Reclamation requirements will be specified in the land use permit.

FIGURE 43. A reclamation goal could be to return the land to a stable condition by revegetating the site.

8.2 Reclamation Activities

Progressive reclamation should be conducted throughout construction and operation to reduce soil erosion and the length of time a site is disturbed. This can include activities such as revegetating ditches and reclaiming unused sections of roads, quarries and shoo flys. Reclamation of the cleared right-of-way adjacent to the road can be helped by leaving tree roots and shrubs in place during clearing and scattering brush to create micro-sites for native seeds.

Final site reclamation will occur when the road is no longer required. Monitoring after reclamation activities are complete will determine if reclamation has met the goals specified in the closure and reclamation plan. Monitoring the performance of progressive reclamation efforts during operations may shorten final reclamation monitoring requirements if they are found to be successful.

8.2.1 Remove Structures, Equipment and Garbage

During reclamation or extended shutdown of operations, all garbage, petroleum products and equipment should be removed from the road. For final reclamation, buildings should also be removed. If the road is being permanently decommissioned, culverts should be removed carefully to avoid sedimentation, and the stream bed and banks should be re-established. Where culverts are removed, cross ditches should be constructed across the road to maintain drainage.

FIGURE 44. This reclaimed site is well contoured and revegetated, but the culvert should be removed.

FIGURE 45. Erosion control can include the use of mats and planting willow cuttings.

8.2.2 Erosion Control

Areas that are not prone to erosion generally require minimal contouring and can be left to revegetate naturally. For instance, on flat sections of the route, stockpiled organic topsoil can be replaced evenly on the road surface and the surface can be scarified to provide sites for natural re-seeding.

On steep slopes, adequate cross drainage is required across the reclaimed road using cross ditches or berms. For slopes where soil erosion is a greater concern, active revegetation by seeding or planting should be conducted to achieve soil stability and restore the natural appearance of the site. The INAC resource management officer and territorial environment department should be contacted for information on approved seed mixes. Further erosion control measures include:

- planting shrub cuttings, such as willows;
- mulching and spreading;
- erosion control mats;
- soil binders;
- rock or gravel blankets; and
- creating terraces.

8.2.3 Restrict Access

Public use of reclaimed roads may disturb erosion control structures. To prevent public use of reclaimed roads, barriers can be constructed at their intersection with public roads. An effective method is to spread slash and debris on the right-of-way near the intersection.

8.3 Reclamation Monitoring

Monitoring will be required for several years after reclamation activities are completed to assess whether the closure objectives have been met. Monitoring requirements will usually be specified in the land use permit. Post-closure monitoring should attempt to answer the following questions:

- Are erosion control structures performing as designed?
- Are water management techniques effectively controlling water on and adjacent to the right-of-way?
- Has vegetation been re-established to predicted levels?

If monitoring demonstrates that some reclamation techniques have been unsuccessful, additional reclamation work may be required. When the land use regulator is satisfied that the site is stable and the reclamation objectives have been met, a letter of final clearance will be issued indicating that the permit holder is no longer responsible for the road or trail.

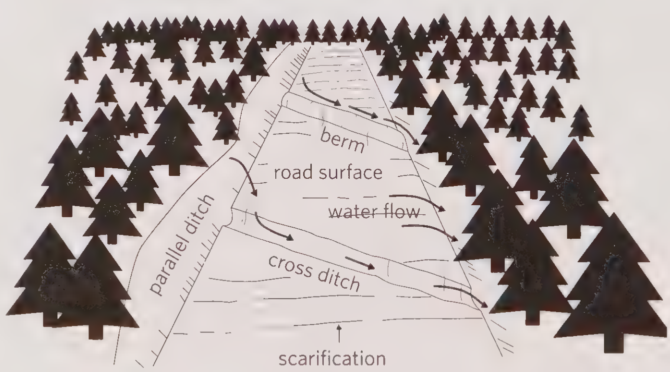


FIGURE 46. Berms and cross drains can be installed along the right-of-way to deflect water into surrounding vegetation and to control access. (1994 INAC Access Roads and Trails Guidelines)

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Glossary

Berm

Low earth mound constructed in the path of flowing water to divert its direction.

Binder

Substance that encourages the adherence of soil particles, such as a chemical mat.

Borrow pit

Pit created to provide earth materials to be used as fill at another site.

Buffer strip

Area of land left untouched to provide a natural barrier between a development area and an adjacent area. Buffers can be used to protect important ecosystem components, such as wildlife habitat or water bodies, or they can be used to provide a visual barrier between a development area and an area of human use.

Cross ditch

Shallow trench excavated across a road to drain water in the downslope direction.

Cross drain

Pipe that extends through the roadbed to drain water from the uphill side of the road.

Cut and fill

Construction practice in which earth materials are excavated from part of an area and used as fill in adjacent areas.

Cribbing

Support structure usually built of timbers or logs, but can be of concrete or steel.

Ditch block

Barrier constructed within a ditch to control water speed and trap sediment, which could include logs, cleared vegetation or rocks.

Dogleg

Sharp change in the direction of a road. Designed to conceal the road from view for aesthetic purposes.

Dragging

Method of smoothing a road surface by pulling a heavy object behind a moving vehicle.

End dumping

A method of road building where material is dumped onto the ground surface, spread, and graded. Construction continues by driving to the end of the road and dumping another load.

Esker

Long, narrow ridge of coarse gravel and granular materials deposited by glacial meltwater.

Fording

Crossing a stream by driving a vehicle through it.

Freshet

Rapid rise in stream flow due to runoff from snowmelt during spring.

Ground ice

Ice present in ground materials. It dominates the geotechnical properties of the material and can cause terrain instability if it melts.

Grubbing

Removal of stumps, roots, brush and excess organic matter from the route.

Heritage resources

Historic, cultural or natural resource that has been identified by a community, territory or the federal government as being representative of the history or culture of an area.

Hummock

Small mound of mineral soil, largely silt and clay, formed by differential frost heave that makes the ground irregular.

Parallel ditch

Trough that runs beside the road.

Peatland

Poorly drained organic terrain characterized by a high water table and the presence of permafrost.

Permafrost

Ground frozen for at least two consecutive years. Continuous permafrost is defined as an area where at least 90 percent of the land area is underlain by permafrost. Discontinuous permafrost is defined as an area where 10 to 90 percent of the land area is underlain by permafrost.

Progressive reclamation

Action that can be taken during operations before permanent closure to take advantage of cost and operating efficiencies by using resources available from ongoing operations. Enhances environmental protection and shortens the time frame for achieving reclamation objectives.

Pushouts

Trees that have been pushed down, off the right-of-way, as a result of clearing.

Riparian

Area of land adjacent to a stream, river, lake or wetland containing vegetation that, due to the presence of water, is distinctly different from the vegetation of adjacent upland areas.

Rip-rap

Layer of large stones or broken rock placed on an embankment for erosion control and protection.

Rutting

Depressions in soil, soil erosion and ponding that are the result of repeatedly operating heavy equipment on wet, unfrozen soils.

Shoo fly

Temporary access road built around a steep or difficult section of a right-of-way so that equipment can traverse the area without damaging the ground.

Slash

Woody debris, such as branches, logs and brush, that remains on the ground after clearing has been completed.

Subsidence

The gradual sinking or downward settling of the earth's surface in response to geologic or man-induced causes.

Thermokarst

Terrain characterized by pits and depressions caused by permafrost degradation and melting of ground ice.

Tussock

Thick clump of grass or sedge that can be up to 1 m in height formed by the accumulation of dead vegetation.

Watershed

Area of land that drains water into a particular stream, river or lake.

Windrow

Woody debris that has been piled into a long, continuous row.

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